The Veliger 35(3):177–194 (July 1, 1992)

THE VELIGER

Comments on and Descriptions of Eulimid Gastropods from Tropical West America

by

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Abstract. The author and date of the family name Eulimidae is corrected from H. & A. Adams, 1853, to Philippi, 1853, on the basis of priority. *Turveria* ***pallida*** sp. nov. is described from the Gulf of California. It is ectoparasitic on the sand dollar *Encope grandis* L. Agassiz, 1841. ***Microeulima*** gen. nov. is described with the type species *Alaba terebralis* Carpenter, 1857 (*Eulima proca* de Folin, 1867 = *Leiostraca schwengelae* Bartsch, 1938 = *Strombiformis hemphilli* Bartsch, 1917 [new synonyms]). This species occurs from northern Mexico to Ecuador in shallow water. *Strombiformis hemphilli* Dall, 1883, from Florida, is placed in *Microeulima*. *Scalenostoma babylonica* Bartsch, 1917, is a junior synonym of *Chemnitzia rangi* de Folin, 1867, which is transferred from *Scalenostoma* to *Niso* Risso, 1826. *Eulimostraca* Bartsch, 1917 is discussed and *E.* ***macleani*** sp. nov. is described from Costa Rica. *Strombiformis burragei* Bartsch, 1917 (= *Melanella panamensis* Bartsch, 1917 [new synonym]) and *Leiostraca linearis* Carpenter, 1857, are transferred to *Eulimostraca* (all from western Mexico and Central America). ***Eulimetta pagoda*** gen. et sp. nov. is described from western Central America. Its host species is unknown. *Sabinella* ***shaskyi*** sp. nov. is described from western Central America. It lives in galls in the spines of the cidaroid sea urchin *Eucidaris thourarsi* (Valenciennes, 1846).

INTRODUCTION

The family Eulimidae contains a large number of species, almost exclusively parasitic on echinoderms. The shell morphology is highly diverse and there are, in addition to species of "typical eulimid" appearance, also limpets and shell-less species in the family (WARÉN, 1984b).

To some extent the development of the shell depends on the animal's sex or on the presence or absence of additional individuals of the same species, which in some species determine the sex of newly settled larvae (WARÉN, 1984b). This complicates specific classification, but the problem can be overcome by a comparison of larval shells, which are identical within a species.

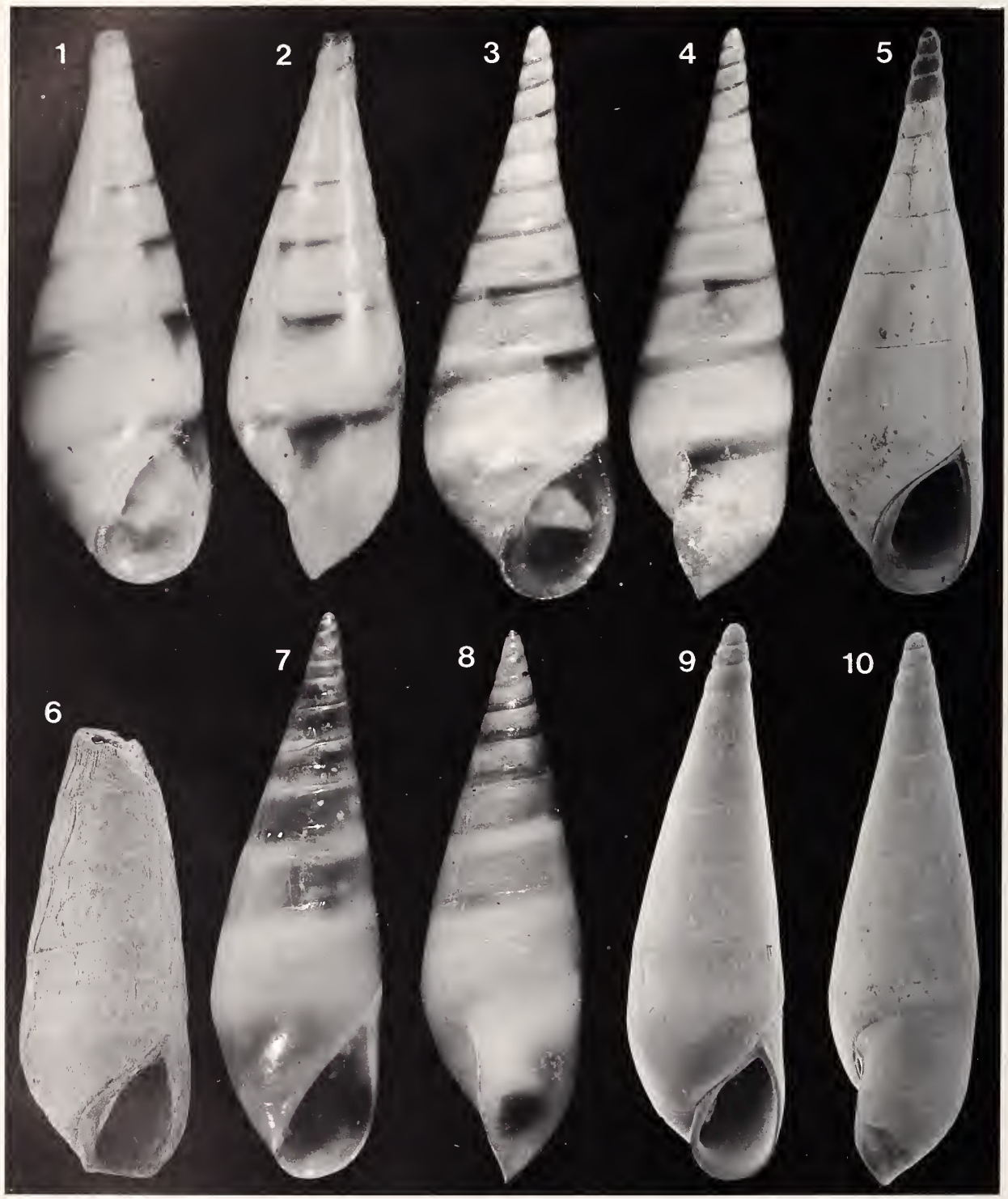
This paper presents some of the results of an examination of the West American eulimid collections in the Los Angeles County Museum of Natural History and the U.S. National Museum of Natural History, made some 15 years ago. During the intervening years I had hoped to obtain further material of the species discussed here, to be able to describe them in more detail and consolidate their systematic position. This has failed, however, except for the new species of *Turveria* and *Sabinella*. Nevertheless, I describe them here in an attempt to draw the attention of workers to them.

When looking for eulimids, it is always useful to examine echinoderms, which are usually their hosts. This can easily be done by selecting a common echinoderm species and, after a brief examination of each specimen, shaking them in a bucket with brackish water or seawater with some cleansing substance added (*e.g.,* formalin or detergent). Afterwards the residue on the bottom of the bucket is searched for specimens. If any are found, they should be saved together with at least one specimen of the host. This procedure is quite profitable, and frequently yields undescribed species, in addition to invaluable information about species already known.

Abbreviations and Conventions Used in Text

BMNH—Natural History Museum, London.
LACM—Los Angeles County Museum of Natural History, Los Angeles, California.
SMNH—Swedish Museum of Natural History, Stockholm.
USFC—United States Fish Commission.
USNM—National Museum of Natural History, Washington, D.C.

In the ennumerations of examined material, "shell" is



Explanation of Figures 1 to 10

Figures 1 and 2. *Microeulima terebralis,* holotype of *Leiostraca schwengelae,* USNM 127554, 3.12 mm.

Figures 3 and 4. *Microeulima terebralis,* Costa Rica, LACM 72-46.16, front view (2.80 mm) and side view (3.28 mm).

Figure 5. *Microeulima terebralis,* Costa Rica, LACM 72-42.20, front view 2.94 mm.

used for empty shells, whereas "specimen" is used for shells containing dried or preserved soft parts.

SYSTEMATICS

Family Eulimidae Philippi, 1853

The family name has usually been ascribed to H. & A. Adams (1853:235) (Warén, 1984b; Ponder & Warén, 1988). The name was published by the Adams brothers in the eighth section of their monograph, which was issued December 1853. This is later than the publication by Philippi (1853:194), which was published before May 1853, since Philippi's book was reviewed by Petit (1853) in the May issue of the *Journal de Conchyliologie*. The correct author of the family is thus Philippi, 1853.

Turveria Berry, 1956

Turveria Berry, 1956:356. Type species, by original designation, *Turveria encopendema* Berry, 1956, Mexico, Baja California Sur, on sand dollars, *Encope* spp. (Scutellidae).

Remarks: The genus was redescribed by Warén (1991), and two species parasitic on sand dollars in the Gulf of California were included. The second species was wrongly identified as *Turveria schwengelae* Bartsch, 1938, a mistake which is corrected below.

Little is known about the biology of the species of *Turveria,* except that they are regularly found on specimens of sand dollars belonging to the genus *Encope* L. Agassiz, 1841, a genus endemic to the southeastern United States, the Caribbean, Galapagos, and the American west coast from California to Ecuador (Mortensen, 1948).

Turveria ***pallida*** Warén, sp. nov.

(Figures 7, 8, 13)

Turveria schwengelae: Warén 1991:108, figs. 10A, B, 13F, G (not Bartsch, 1938).

Type material: Holotype LACM 2425 (from LACM 55554) and 2 paratypes LACM 2426 (from LACM 55553), 2 paratypes SMNH 4122 (from LACM 55554; for locality data see "Material examined"). Further paratypes, 12 specimens SMNH 4141 and numerous specimens in D. Shasky collection, from the same locality.

Type locality: Mexico, Baja California Norte, sand flats at Isla Willard, Bahia San Luis Gonzaga, 29°57′N, 114°17′W, on *Encope grandis,* 3 specimens, LACM 55554.

Material examined: The type material and Mexico: Baja California Sur, Bahia Concepcion, 26°42′N, 11°55′W, 1 shell, no host (LACM 63-37.3); Baja California Norte, Isla Willard, Bahia San Luis Gonzaga, 29°57′N, 114°17′W, on *Encope* sp., 4 specimens (LACM 55553 [paratypes LACM 2426 and SMNH 4122]); Baja California Norte, Bahia San Luis Gonzaga, 29°57′N, 114°17′W, on *Encope grandis,* intertidal, 36 specimens (D. Shasky collection [12 specimens paratypes SMNH 4141]).

Description: (Sex not known.) The shell (Figures 7, 8) is conically lanceolate, solid, smooth, transparent, with brownish markings along the suture and on the outer lip. The larval shell (Figure 13) consists of about 2.7 distinctly convex whorls and is smooth and colorless except for an occasional brownish tint on the initial whorl. The visible height of the larval shell is 260 μm, and the total height of the shell of the larva is estimated to about 290 μm. The holotype has 7.25 teleoconch whorls of slowly and uniformly increasing diameter, sculptured by numerous dense and sharp incremental lines. The teleoconch of the holotype has nine incremental scars (1.2, 1.9, 2.8, 3.8, 4.3, 4.8, 5.5, 6.0, and 6.6 whorls from the outer lip) but as usual there is some individual variation in this character. The suture is shallow but distinct and makes a conspicuous bend downwards about 0.3 mm before the outer lip. The aperture is constricted in its upper part as a consequence of this and is pear-shaped. The outer lip is distinctly prosocline, with a shallow sinus below the suture. The color pattern is not as bright as in *Turveria encopendema,* and consists of a brownish spiral band just below the periphery of the body whorl. This band is concealed under, or visible through, the subsutural zone on earlier whorls. There is also a large, roundedly triangular blotch at the lower part of the outer lip and one less-distinct, sometimes absent, similar spot just below the corner between the outer lip and the suture.

Dimensions. Height of holotype 5.23 mm, maximum height 5.8 mm.

Remarks: *Turveria* ***pallida*** differs from *T. encopendema* by having a regularly conical spire, flatter whorls, and less vivid color pattern, and by being about ⅛ taller (shell height 4.91 ± 0.27 mm [SD] among 23 mature specimens; compared with 4.18 ± 0.27 mm among 26 specimens of *T. encopendema*).

Eulima Risso, 1826

Eulima Risso, 1826:123, type species pending (Warén, 1992), suggested to be *Strombiformis glaber* Da Costa, 1778, European.

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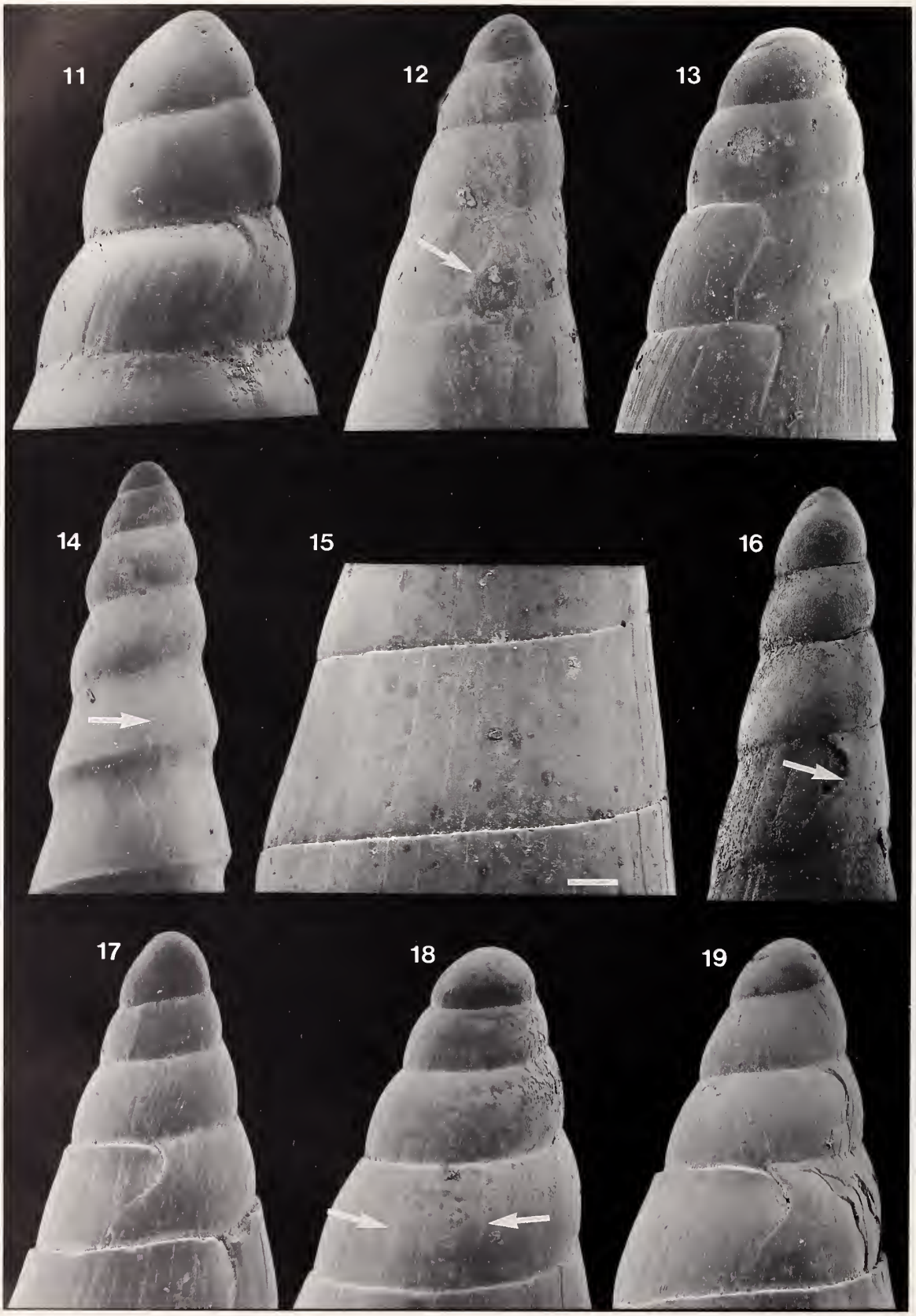
Figure 6. *Microeulima* sp. from the sea urchin *Chaetodiadema granulatum,* northwest of Koh-si-Chang, Thailand, 18 m depth, height 3 mm. Zoological Museum of the University of Copenhagen.

Figures 7 and 8. *Turveria pallida,* paratypes, LACM 2426, side view 4.88 mm and front view 4.96 mm.

Figures 9 and 10. *Microeulima hemphilli,* Florida, syntype, USNM 35983, height 3.1 mm.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Remarks: The genus *Eulima* was described anatomically by WARÉN (1984a). The hosts are known for two European species, in both cases ophiuroids (WARÉN, 1984a, and unpublished data). Almost all species that at present can be classified in *Eulima* still remain unknown with respect to anatomy and host choice.

The species of *Eulima s.s.* have a tall (7–20 mm), slender shell, usually with a brownish color pattern, flat whorls, and a tall aperture with a rather straight profile of the outer lip. The animal is not very modified anatomically and retains a small stomach and a buccal mass with a ptenoglossate radula. The type species is a sand dweller, parasitic on ophiuroids, and has large epipodial folds, partly covering the base of the shell in order to facilitate the movements in the sand.

The generic name *Strombiformis* Da Costa, 1778, has been used extensively in American literature, but the type species is an European pulmonate (WARÉN, 1984b).

BARTSCH (1917) revised the western American eulimids and classified several species in *Strombiformis*. Of the West American species the following seem to belong to *Eulima s.s.*, judging from shell characters: *S. almo* Bartsch, 1917; *S. barthelowi* Bartsch, 1917; *S. californica* Bartsch, 1917; *Eulima fuscostrigata* Carpenter, 1864; *S. lapazana* Bartsch, 1917; *S. panamensis* Bartsch, 1917; *Eulima recta* C. B. Adams, 1852; *S. townsendi* Bartsch, 1917; and *E. varians* Sowerby, 1834. BARTSCH (1926) also described *Strombiformis hua, S. salsa, S. inca,* and *S. paria,* all of which belong to *Eulima s.s.* Not all of these names represent different species, but I am not prepared to present a detailed synonymy.

A large proportion of all the species of Eulimidae were originally described in *Eulima,* and are still placed there. Therefore I have frequently placed species provisionally in *Eulima,* instead of describing new genera for them.

Microeulima Warén, gen. nov.

Type species: *Alaba terebralis* Carpenter, 1857, western Central America.

Diagnosis: Small eulimids, 2.5–5 mm high, with a slender, lanceolate shell of slowly increasing diameter, flat whorls, and brownish color, either as sutural and collabral bands or uniformly all over shell. Fine, sharp, indistinct axial lines present. Aperture constricted in its right corner, evenly and broadly rounded at opposite end. Outer lip with distinct subsutural sinus. Parietal callus thick and abruptly demarcated.

Etymology: ***Microeulima,*** from Greek *mikros,* meaning "small," and *Eulima,* referring to the similarity to species of *Eulima s.s.*

Remarks: I hesitated much before describing this new genus since there is neither a species of which soft parts have been examined, nor a named species for which the host is known. The group of species I classify here is, however, well demarcated, and there are numerous species in tropical areas, almost all of them undescribed.

The host is known for a single species, but the shell is in such bad condition that it cannot be described or specifically identified, although the aperture indicates that it belongs to ***Microeulima.*** This species was found by T. Mortensen (unpublished data) parasitizing the diadematid sea urchin *Chaetodiadema granulatum* Mortensen, 1903, in Thailand, northwest of Koh-si-Chang, in 18 m depth. The shell (Figure 6) has a broken apex and the surface is corroded, but the soft parts remain.

In this genus belongs *Strombiformis hemphilli* (Dall, 1883) which was described from Cedar Keys, Levy County, Florida, and later (LYONS 1989:16) recorded from several localities at Hutchinson Island, off Indian River, St. Lucie County, eastern Florida. I figure one of the two syntypes (Figures 9, 10). The shell of this species is uniformly chestnut brown.

The genus *Eulimostraca* (see below) bears some resemblance to ***Microeulima,*** but the shape of the shell is regularly conical with a larger aperture and it lacks the axial lines typical for ***Microeulima.***

Microeulima also resembles *Turveria,* but species of that genus lack the strongly developed parietal callus.

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Explanation of Figures 11 to 19

Figure 11. *Eulimostraca macleani,* paratype, LACM 2371, height of larval shell 390 μm.

Figure 12. *Eulimostraca galapagensis,* paratype, USNM 251281, height of larval shell 400 μm.

Figure 13. *Turveria pallida,* paratype, LACM 2426, height of larval shell 260 μm.

Figure 14. *Eulimetta pagoda,* holotype, LACM 2372, height of larval shell 210 μm.

Figure 15. *Niso interrupta,* Mexico, near Guaymas, Bahia Bacochibampo, 9–18 m, LACM 55558. Scale line 0.25 mm.

Figure 16. *Microeulima terebralis,* Costa Rica, LACM 72-42.20, height of larval shell 490 μm.

Figure 17. *Niso rangi,* Costa Rica, LACM 72-52.22, height of larval shell 370 μm.

Figure 18. *Niso interrupta,* LACM 55558, for collection data see Figure 15, height of larval shell 490 μm. Left arrow indicates a teleoconch growth line, right arrow a protoconch growth line.

Figure 19. *Niso hipolitensis,* Mexico. Baja California Sur, Punta Palmilla, intertidal, LACM 66-11.5, height of larval shell 390 μm.

Eulimostraca bartschi Strong & Hertlein, 1937, known from two localities in western Mexico (HERTZ & HERTZ, 1982), probably belongs to ***Microeulima,*** but I have not examined any specimens.

Microeulima terebralis (Carpenter, 1857)

(Figures 1–5, 16)

Alaba terebralis CARPENTER, 1857:367.
Leiostraca sp. ind. (b): CARPENTER 1857:440.
Eulima proca DE FOLIN, 1867:62, pl. 6, fig. 3 (new synonym).
Strombiformis hemphilli BARTSCH, 1917:344, pl. 47, fig. 4 (not Dall, 1889) (new synonym).
Leiostraca schwengelae BARTSCH, 1938:34 (replacement name for *Strombiformis hemphilli* Bartsch, 1917).
Alaba terebralis: BRANN 1966:pl. 40, fig. 427.
Leiostraca sp. ind. (b): BRANN 1966:pl. 40, fig. 553.
Eulima? *terebralis*: KEEN 1968:424, text fig. 108.

Type materials: *Alaba terebralis,* holotype BMNH 1854.6.4.427; *E. proca,* 1 syntype BMNH 1868.2.17.13; *S. hemphilli,* holotype USNM 127554 (Figures 1, 2).

Type localities: *Alaba terebralis,* W Mexico, Sinaba, Mazatlan, "off *Spondylus*" (living on?); *E. proca,* Panama, Achipelago de las Pearlas; *S. hemphilli,* Baja California Sur, shell drift at Punta Abreojos.

Materials examined: The type material and MEXICO: Pacific side of Baja California Norte, Isla Cedros, 1.6 km (1 mile) N of Cedros Village, 5–8 m depth, 28°06′N, 115°10′W, 2 shells (LACM 67-65.10); Pacific side of Baja California Sur, Cabo Thurloe, 27°37.5°N, 114°14.9′W, 15–20 m depth, 4 shells (LACM 71-170.9); Pacific side of Baja California Sur, Punta San Pablo, 27°12.5′N, 114°28.9′W, 20–30 m, 1 shell (LACM 71-178.14); Pacific side of Baja California Sur, Isla Asunción, E Anchorage, 27°06′N, 114°17′W, 8–23 m, 3 shells (LACM 67-66.13); Golfo de California, Baja California Sur, Bahia Concepcion, 26°42′N, 111°55′W, shallow depth, 17 shells (LACM 63-37.4); Pacific side of Baja California Sur, Bahia Magdalena, Man of War Cove, 24°37.5′N, 112°7.5′W, 0–12 m depth, 1 shell (LACM 71-183.10); Sinaloa, Mazatlan, N of Olas Altas Lighthouse, 23°12′N, 106°27′W, intertidal, 1 shell (LACM 46-9.1); Sinaloa, vicinity of Mazatlan, 23°11′N, 106°26′W, 0–6 m, 4 shells (LACM 63-11.15); Nayarit, 72 km (45 miles) NW of San Blas, Isla Isabela, 21°51′N, 105°55′W, 10 m depth, 1 shell (LACM 67-9.1). COSTA RICA: Puntarenas Province, Islas Tortugas, 1 km W of Isla Alcatraz, 09°47′N, 84°53.5′W, 2–8 m depth, 9 shells (LACM 72-46.16); Puntarenas Province, Bahia Ballena, 2 km (1.5 miles) E of Punta Ballena, 09°44.3′N, 84°33.8′W, 3–16 m depth, 8 shells (LACM 72-42.20); Puntarenas Province, Bahia Ballena, 09°44′N, 84°33′W, 1–13 m depth, 65 specimens (D. Shasky collection); Puntarenas Province, Bahia Herradura, 09°38.8′N, 84°41′W, 10–12 m depth, 2 shells (LACM 72-52.21); Puntarenas Province, Bahia Herradura, 09°38.0′N, 84°40.5′W, 23 m depth, 4 shells (LACM 72-53.5); Puntarenas Province, Islets off Punta Quepos, 09°22.7′N, 84°09.7′W, 13–25 m depth, 9 shells (LACM 72-58.21). PANAMA: Canal Zone, off sandspit leading to Isla Venado, 08°53′N, 79°36′W, intertidal, 1 shell (LACM 75-54.12); Fort Amador, Isla Perico, 08°51′N, 79°35′W, intertidal, 1 shell (D. Shasky collection); Isla Vendao, intertidal, 7 shells (D. Shasky collection); Bahia de Panama, Isla Bona, Isla Otoque, 08°36′N, 79°39′W, 10–27 m depth, 1 shell (LACM 65-21.19); Bahia de Panama, Isla Taboga, 08°35′N, 79°30′W, 2–5 m depth, 2 shells (LACM 62-25.17); Archipelago de las Perlas, Isla Buyarena, 08.5°N, 79°W, intertidal, 1 shell (D. Shasky collection); Archipelago de las Perlas, Isla Pedro Gonzales, 08.5°N, 79°W, intertidal, 1 specimen (D. Shasky collection). ECUADOR: Guayas Province, Santa Elena Peninsula, NW side of Punta Ancon, 02°19.5′S, 80°54.0′W, intertidal, 1 shell (LACM 70-11.6); Guayas Province, Santa Elena Peninsula, W side of Punta Ancon, 02°19′S, 80°54′W, intertial, 6 shells (D. Shasky collection).

Distribution: East Pacific, western Mexico to Ecuador, intertidal to 25 m depth.

Remarks: The holotype of *Leiostraca schwengelae* (Figures 1, 2) has lost most of the characteristic, tall-spired protoconch. Examination of the holotype, available only after proofreading the revision of *Hypermastus* and *Turveria* (WARÉN, 1991), made me realize the mistake and made the synonymy with *Alaba terebralis* obvious. *Alaba terebralis* was based on only a fragment with two teleoconch whorls and two whorls of the larval shell left. The syntype of *Eulima proca* is in good condition.

The height of the larval shell is about 500 μm and it consists of slightly more than three whorls. This is almost twice the height of the larval shell of the otherwise somewhat similar species of *Turveria.* These, however, have a larger teleoconch (4–5 mm), and are broader with a relatively higher aperture.

Like many of the eulimids with a color pattern, this species has regularly appearing thin and sharp collabral lines on the whorls.

Scalenostoma Deshayes, 1863

Scalenostoma DESHAYES, 1863:58. Type species, *S. carinata* Deshayes, 1863, by monotypy, La Reunion, Indian Ocean.

Remarks: Species of *Scalenostoma* inhabit cavities in living specimens of hermatypic corals in shallow water in tropical regions (WARÉN, 1980). Presumably they use their long proboscis to parasitize the surrounding polyps of the coral. They are likely to belong to the Eulimidae (but no well preserved specimens have been available for anatomical examination). If this assumption is correct, they differ from most eulimids in not parasitizing echinoderms. The association with cnidarians indicates a possibility that they are related to the Epitonidae, but the apical whorls (including the larval shell) are so similar to eulimids that they have frequently been identified as species of that family.

The species are highly variable, large, with a transparent, colorless shell up to 30 mm high. The first 8–10 whorls

look like a specimen belonging to *Vitreolina* Monterosato, 1884 (Eulimidae), 2–5 mm high, with flat whorls and twisted spire. The growth pattern then suddenly changes and the whorls become fatter and more irregularly coiled.

Scalenostoma subulata (Broderip, 1832) has been reported from Isla Cascara, Cocos Island, Costa Rica by Shasky (1983b), who found six primary females, one secondary female, and 10 males in cavities in a piece of living coral from 25 m depth. I take this occasion to figure some of them (Figures 55–59).

Two species have been described from western Central America, *Chemnitzia rangi* de Folin, 1867, and *Scalenostoma babylonica* Bartsch, 1917, which usually have been classified in *Scalenostoma*. They do not conform with the type species, however, except in frequently having the lower whorls sharply keeled, which by itself is not a diagnostic feature. They are here transferred to *Niso* Risso, 1826, on the basis of shell characters specified below.

Niso Risso, 1826

Niso Risso, 1826:218. Type species, *Niso eburnea* Risso, 1826, by monotypy, Pleistocene of southern Europe.

Remarks: One undescribed species of *Niso*, from New Caledonia, is known to parasitize a starfish (Warén, 1984b) and work is underway to describe the anatomy of that species. That species and the type species, *N. eburnea*, are very similar to *Niso interrupta* Sowerby, 1834, a western, Central American species that is used below to exemplify the characters of the genus.

Emerson (1965) revised the West American species and McLean (1970) described *Niso emersoni* from Panama. Hertz & Hertz (1982) described *Eulimostraca attilioi* from off La Jolla, California, and commented on the similarity to *Niso*, but placed the species in *Eulimostraca* because it has almost no umbilicus. I consider this character less important than the great similarities in other details, including microsculpture, larval shell, size, and color pattern, and transfer it to *Niso*. Hertz & Hertz (1982) also placed *N. hipolitensis* in *Eulimostraca*, because of the lack of a well developed umbilicus. I agree with other authors (Bartsch, 1917; Emerson, 1965) that *hipolitensis* shows more affinity to *Niso* and suggest that it is kept there.

Niso rangi (de Folin, 1867)

(Figures 17, 20–22, 25–27, 30, 31)

Chemnitzia rangi de Folin, 1967:61, pl. VI fig. 1.
Scalenostoma babylonica Bartsch, 1917:338, pl. 45 fig. 2.

Type materials: *Chemnitza rangi*, lost, not in BMNH, MNHN, or Biarritz (Kisch, 1959; P. Bouchet, personal communication); *Scalenostoma babylonica*, holotype and 1 paratype, USNM 127542 (Figure 20).

Type localities: *C. rangi*, Bahia de Panama, Archipelago de las Pearlas; *S. babylonica*, Baja California Sur, Punta San Hipolito.

Material examined: The type material and Mexico: Pacific side of Baja California Sur, Punta San Pablo Anchorage, 21–24 m, 1 shell (LACM 71-177.5). El Salvador: La Unión Province, Golfo de Fonseca, Isla Zacatillo, 13°18′N, 87°46′W, 2 m, 2 shells (LACM 73-57.1). Costa Rica: Guanancaste Province, N of Bahia Potrero, Punta Penca, 10°29.3′N, 85°48.9′W, 8–13 m, 2 shells (LACM 72-38.7); Puntarenas Province, 1 km W of Isla Alcatraz, Isla Trotugas, 09°47.0′N, 84°53.5′W, 1.5–8 m, 3 shells (LACM 72-46.17); Puntarenas Province, Bahia Ballena, 2.4 km E of Punta Ballena, 09°44.3′N, 84°33.8′W, 3–16 m, 1 shell (LACM 72-42.21); Puntarenas Province, W side of Bahia Ballena, 09°44′N, 84°33′W, 6–10 m, 2 shells (D. Shasky collection); Puntarenas Province, Bahia Ballena, 09°44′N, 84°33′W, 13–15 m, 2 shells (D. Shasky collection); Puntarenas Province, off Bahia Herradura, 09°38.9′N, 84°40.9′W, 6 m, 1 shell (LACM 72-54.13); Puntarenas Province, Bahia Herradura, reef at N end of bay, 09°38.8′N, 84°40.9′W, 10–18 m, 10 shells (LACM 72-52.22); Puntarenas Province, Bahia Herradura, 09°38.0′N, 84°40.5′W, 23 m, 6 shells (LACM 72-53.6); Puntarenas Province, anchorage inside small islet, 1.5 km S of Punta Quepos, 09°22.7′N, 84°09.7′W, 23 m, 3 shells (LACM 72-57.5); Puntarenas Province, small islets off Quepos, 09°22.2′N, 84°09.3′W, 25 m, 2 shells (LACM 72-59.5); Puntarenas Province, N side of Isla del Cano, 08°43.3′N, 83°53.1′W, 8–13 m, 3 shells (LACM 72-63.28); Puntarenas Province, 2 km NW of Rincon de Osa, head of Gulfo de Dulce, 08°43.3′N, 83°28.5′W, 2–16 m, 1 shell (LACM 72-71.14); Isla del Coco, 05°33′N, 87°00′W, 1 shell (coll. K. Kaiser). Ecuador: Guayas Province, N side of Santa Elena Peninsula, E of Salinas, 02°11.5′N, 80°56.5′W, 10 m, 2 shells (LACM 66-114.4); Manabi Province, N side of Isla la Plata, 01°19′S, 81°05′W, 12–30 m, 2 shells (D. Shasky collection); Manabi Province, Isla Salanga, 01°35′S, 79°50′W, 10–15 m, 1 shell (D. Shasky collection).

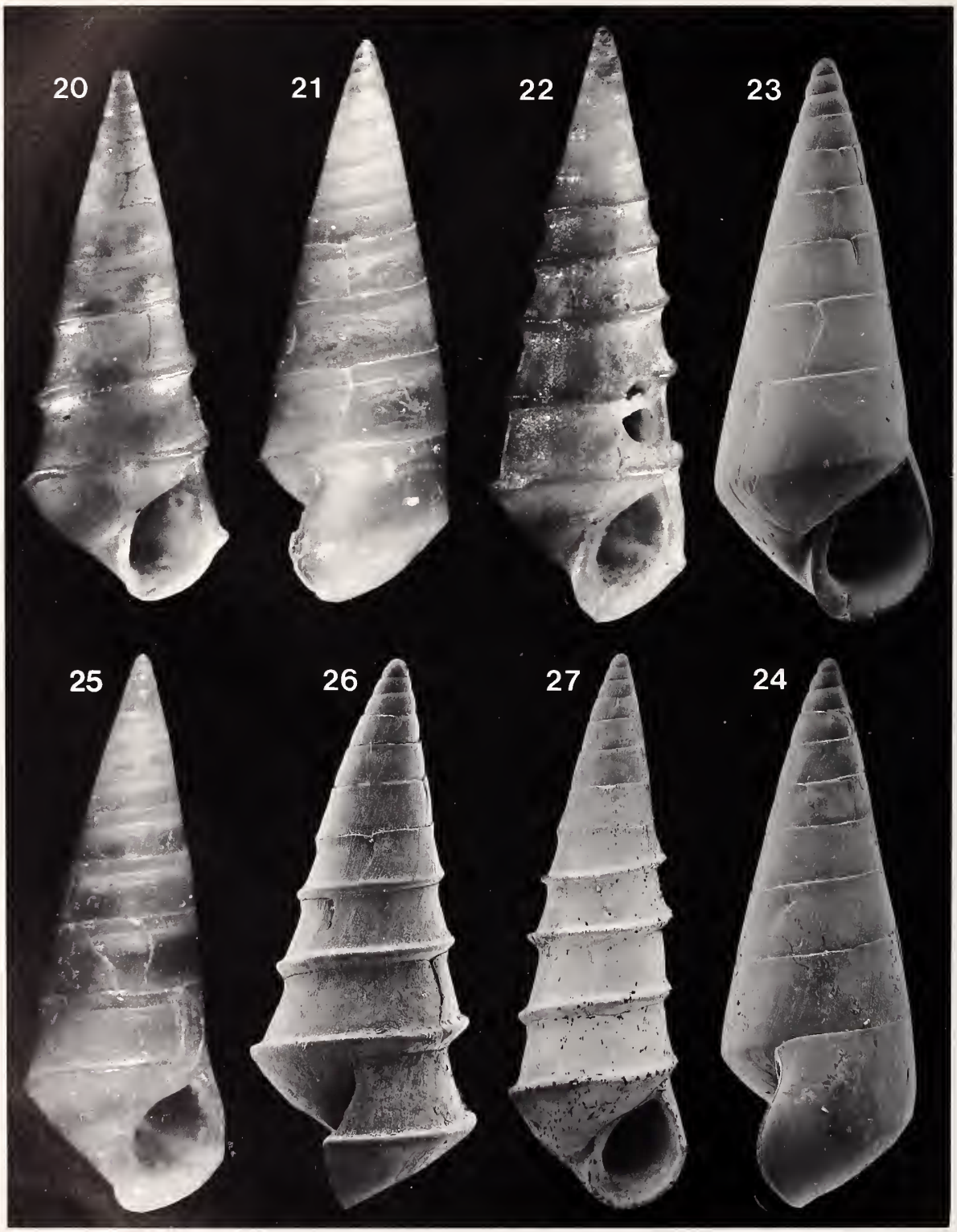
Distribution: Outer coast of Baja Californa Sur from about 27°N to Ecuador, also Cocos Island, in 3–30 m depth.

Remarks: *Niso rangi* is so far known only from empty shells, which makes classification more difficult. For eulimids, however, the shell is unusually rich in characters, which allows the determination of some relationships.

Figures 20–22, 25–27, 30, and 31 show the variation of the shell and that the development of the peripheral keel varies with size and the individual. In addition to what is shown by these figures, it should be mentioned that the shell is dark and dull reddish or yellowish brown.

Bartsch (1917) had access to only two shells when proposing *Scalenostoma babylonica* and de Folin's (1867) drawing is erroneous since it shows all whorls as keeled, although the shell was described as having only the last four whorls keeled. That is evidently the reason why Bartsch (1917) described *N. babylonica*.

Examination of the larval shell (Figure 17) shows that it consists of about 3.5 whorls and has a distinct sculpture



Explanation of Figures 20 to 27

Figure 20. *Niso rangi,* holotype of *Scalenostoma babylonica,* USNM 127542, height 3.0 mm.

Figure 21. *Niso rangi,* Costa Rica, LACM 72-52.22, 2.92 mm.

Figure 22. *Niso rangi,* Costa Rica, LACM 72-59.5, 3.54 mm.

of very fine collabral lines and a height of almost 400 μm. The whole teleoconch is covered by equally sharp but straighter axial lines.

Protoconch sculpture, as well as the color, agrees closely with these features in species of *Niso*. I have exemplified that genus with a young specimen of *N. interrupta* (Sowerby, 1834), a Central American species typical for its genus (shell, Figure 28; larval shell, Figure 18; sculpture, Figure 15) and *N. hipolitensis* Bartsch, 1917 (shell, Figures 23, 24, 29; larval shell, Figure 19).

Both *Niso hipolitensis* and *N. rangi* are unusual among the species of *Niso* in their small size, 3–4 mm shell height, whereas most species of the genus have a shell that is 10–30 mm high, occasionally even higher. Nevertheless I feel satisfied with this systematic position, although it remains to be checked by examination of the soft parts, when such become available.

Niso hipolitensis can be distinguished from young specimens of *N. rangi* by having a blunter protoconch and no trace of an umbilicus. A specimen from Isla Taboga, Panama (in the collection of D. Shasky) indicates a larger size than that given by BARTSCH (1917) namely 4 mm. Had it not been that *N. hipolitensis* was a much more rare species compared with *N. rangi*, I would not have excluded the possibility of the two names having been based on the male and female, respectively, of the same species.

Eulimostraca Bartsch, 1917

Eulimostraca BARTSCH, 1917:333. Type species, by original designation, *Eulimostraca galapagensis* Bartsch, 1917, Galapagos (Figures 12, 33, 35).

Remarks: BARTSCH (1917) placed a single species in *Eulimostraca* when he introduced this generic name, but the genus is represented by several, mostly undescribed species in the Caribbean and western America. Nothing is known about the identity of the hosts of these species.

The species of *Eulimostraca* resemble ***Microeulima***, but species of *Eulimostraca* have a proportionally larger and expanded aperture, giving the shell a regularly conical appearance. The aperture is, however, less expanded and more similar to ***Microeulima*** in young specimens, which indicates that they are related. Also, the larval shells are similar.

Eulimostraca ***macleani***, described below, differs from the typical appearance, but has an aperture very similar to that of *E. galapagensis* and is provisionally included here.

Leiostraca linearis CARPENTER, 1857 (p. 440) (from Mazatlan, Sinaloa, Mexico) was based on a small (1.84 × 0.56 mm) specimen, similar to *Eulimostraca galapagensis*. The holotype has no trace of color pattern, but is otherwise well preserved and differs from *E. galapagensis* by having perfectly flat whorls, by having a slightly more cylindrical shell, and correspondingly by having a smaller aperture. It was figured by BARTSCH (1917:pl. 36, fig. 4), BRANN (1966:pl. 48, fig. 554), and KEEN (1968:text fig. 32, possibly also 1971:fig. 727), and the holotype is in BMNH, Mazatlan collection No. 2025.

Eulimostraca attilioi Hertz & Hertz, 1982, was discussed under *Niso* and transferred to that genus.

Eulimostraca galapagensis Bartsch, 1917

(Figures 12, 33, 35)

Eulimostraca galapagensis BARTSCH, 1917:333, pl. 43, fig. 1.
Eulimostraca galapagensis: SHASKY, 1983a:29.
Eulimostraca galapagensis: HERTZ & HERTZ, 1982:74.

Type material: Holotype and 7 paratypes, USNM 251281.

Type locality: "Galapagos Islands, 72 m."

Material examined: The types and ECUADOR: Galapagos Islands, Isla Isabela, off Tagus Cove, 00°17′S, 91°23′W, 27 m, 1 shell (LACM 34-290.1); Manabi Province, Isla La Plata, 01°16′S, 81°06′W, 30–40 m, 1 shell (D. Shasky collection).

Distribution: Only known from the material examined, Galapagos Islands, 27–72 m depth; also Corinto and Manabi Province, Ecuador.

Remarks: *Eulimostraca galapagensis* can be recognized by its distinctly conical shape and evenly yellowish color in fresh specimens. The periphery is encircled by a darker band.

I have verified SHASKY's (1983a) record by direct comparison with the paratypes.

Eulimostraca burragei (Bartsch, 1917)

Strombiformis burragei BARTSCH, 1917:345, pl. 47 fig. 5.
Melanella panamensis BARTSCH, 1917:311, pl. 36 fig. 1.

Type materials: *Melanella panamensis*, holotype USNM 251312; *Strombiformis burragei*, holotype USNM 267582.

Type localities: *Melanella panamensis*, Bahia de Panama, 110 m; *Strombiformis burragei*, Bahia Concepcion, Golfo de California, 5 m.

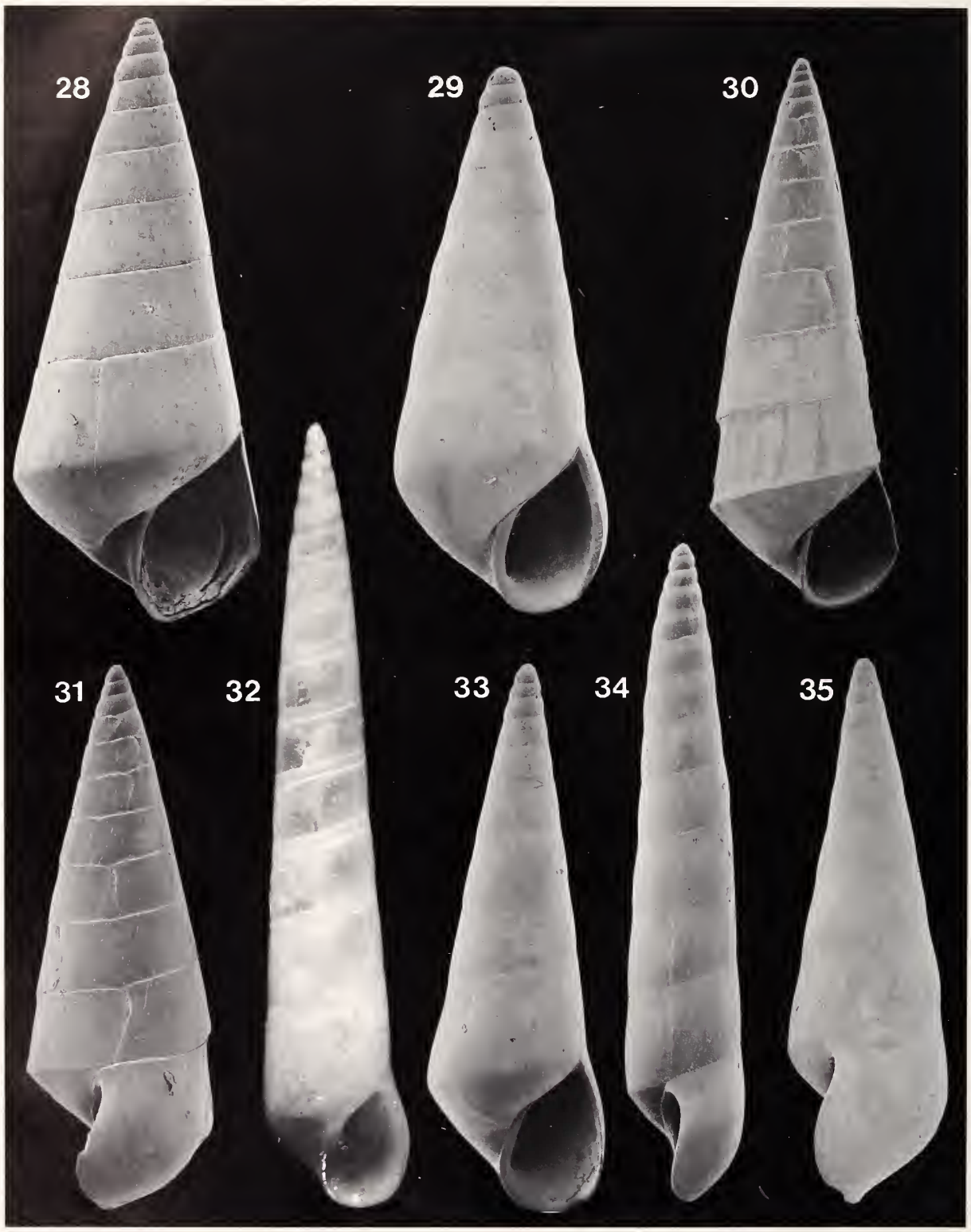
←

Figures 23 and 24. *Niso hipolitensis*, Mexico. Baja California Sur, Punta Palmilla, intertidal, LACM 66-11.5, 2.3 mm.

Figure 25. *Niso rangi*, Costa Rica, LACM 72-38.1, 3.20 mm.

Figure 26. *Niso rangi*, Costa Rica, LACM 72-52.22, 2.68 mm.

Figure 27. *Niso rangi*, Costa Rica, LACM 72-63.28, 3.7 mm.



Explanation of Figures 28 to 35

Figure 28. *Niso interrupta,* LACM 55558, same specimen and data as Figure 15, 4.9 mm.

Figure 29. *Niso hipolitensis,* Galapagos Islands, Isla Isabela, off Tagus Cove, 144 m, LACM 34-290.2, 2.4 mm.

Distribution: Only known from the type specimens, from Golfo de California and Bahia de Panama, in 5–110 m.

Remarks: Examination of the two holotypes of the two names cited in the synonymy did not reveal any differences between them, except for one being more worn. The aperture is less expanded and more ovate than in *Eulimostraca galapagensis,* but this may be because the specimens are not fully mature. If this is the case, I believe the names to be synonyms of *E. galapagensis.* This would not be the first time Bartsch described the same species in three different genera.

As first reviser, I prefer to use the name *burragei* since *panamensis* invites confusion wth *Strombiformis panamensis* Bartsch, 1917, a distinct species belonging to *Eulima.*

Eulimostraca ***macleani*** Warén, sp. nov.

(Figures 11, 32, 34, 40)

Type material: Holotype LACM 2370 and one paratype LACM 2371.

Type locality: Costa Rica, Puntarenas Province, Bahia Herradura, 09°38.0′N, 84°40.5′W, 23 m, LACM 72-53.

Material examined: Only known from the type lot.

Distribution: Only known from the type locality, Costa Rica, in 23 m depth.

Etymology: Named after Dr. James H. McLean, LACM, who always has been very helpful during my visits at the museum.

Description: The shell (Figures 32, 34) is very tall and slender, cylindrical, colorless(?), and transparent, except for a faint brown line along the outer lip and a more distinct blotch on the lower part of the columella. The larval shell (Figure 11) is pointed, with 2.5 perfectly smooth and evenly convex whorls, distinctly demarcated from the teleoconch. The holotype has 11.6 teleoconch whorls, of which the most apical 2 whorls are almost as convex as those of the larval shell and of more rapidly increasing diameter than later whorls. After these, the whorls gradually become flatter and the shell more cylindrical. The body whorl is distinctly angulated at the level of the suture. Starting on the second teleoconch whorl, the surface is covered by a fine spiral striation (Figure 40), barely visible under a good stereomicroscope, and only in patches where incident light is reflected. There are also scattered, occasionally sharp and distinct, usually less distinct, incremental lines. In addition, there are several incremental scars on the apical 3 whorls, then 4 not very distinct incremental scars—5.9, 7.8, 10.1, and 10.6 whorls from the larval shell; but in the paratype the positions are different. The aperture is rather broad, with a distinct subsutural sinus in the outer lip. The parietal wall has a thick callus (inner lip).

Dimensions. Height of the holotype (largest specimen) 6.97 mm.

Remarks: *Eulimostraca* ***macleani*** is probably the most cylindrical eulimid known. I am not aware of any similar species from western America.

Eulimetta Warén, gen. nov.

Type species: ***Eulimetta pagoda*** sp. nov.

Diagnosis: Very small (ca. 2 mm) eulimid, with a brownish shell and a very strong, periodically expanding peripheral keel on the lower whorls.

Etymology: Diminutive of *Eulima.*

Remarks: The development of the keels varies. In one shell it starts almost immediately after the larval shell (Figure 37), but in most specimens it seems not to reach full development. This may be because I have failed to recognize that more than one species is involved, or the cause may be that environmental factors direct the development, as is common in eulimids (see Introduction).

Eulimetta must be rather closely related to *Eulimostraca* and ***Microeulima,*** judging from the shape of the larval shell and the aperture, but I prefer to make a new genus for this strangely shaped species. No other eulimid has a similar expansion of the peripheral keel.

Eulimetta pagoda Warén, sp. nov.

(Figures 14, 36–39, 41)

Type material: Holotype LACM 2372 and two paratypes and LACM 2373.

Type locality: Mexico, Jalisco, Bahia Cuastocemate, 4.8 km (3 miles) NW of Barra de Navidad, 19°13.8′N, 104°44.9′W, 18–36 m, LACM 68-45.

Material examined: The type material and MEXICO: Baja California Norte, 16 km S of Bahia San Luis Gonzaga, Punta Final, 29°48′N, 114°17′W, 36 m, 1 shell (LACM 61-6.3); Baja California Sur, off S end of Isla Espiritu Santo, 24°23′N, 110°20′W, 44 m, 1 shell (LACM 36-140.1); ca. 64 km (40 miles) S of Mazatlan, 22.5°N, 106.5°W, 30–35 m, 2 shells, from shrimp trawler (LACM 60-20.1); Jalisco, E of Punta Mita and off La Cruz, Bahia

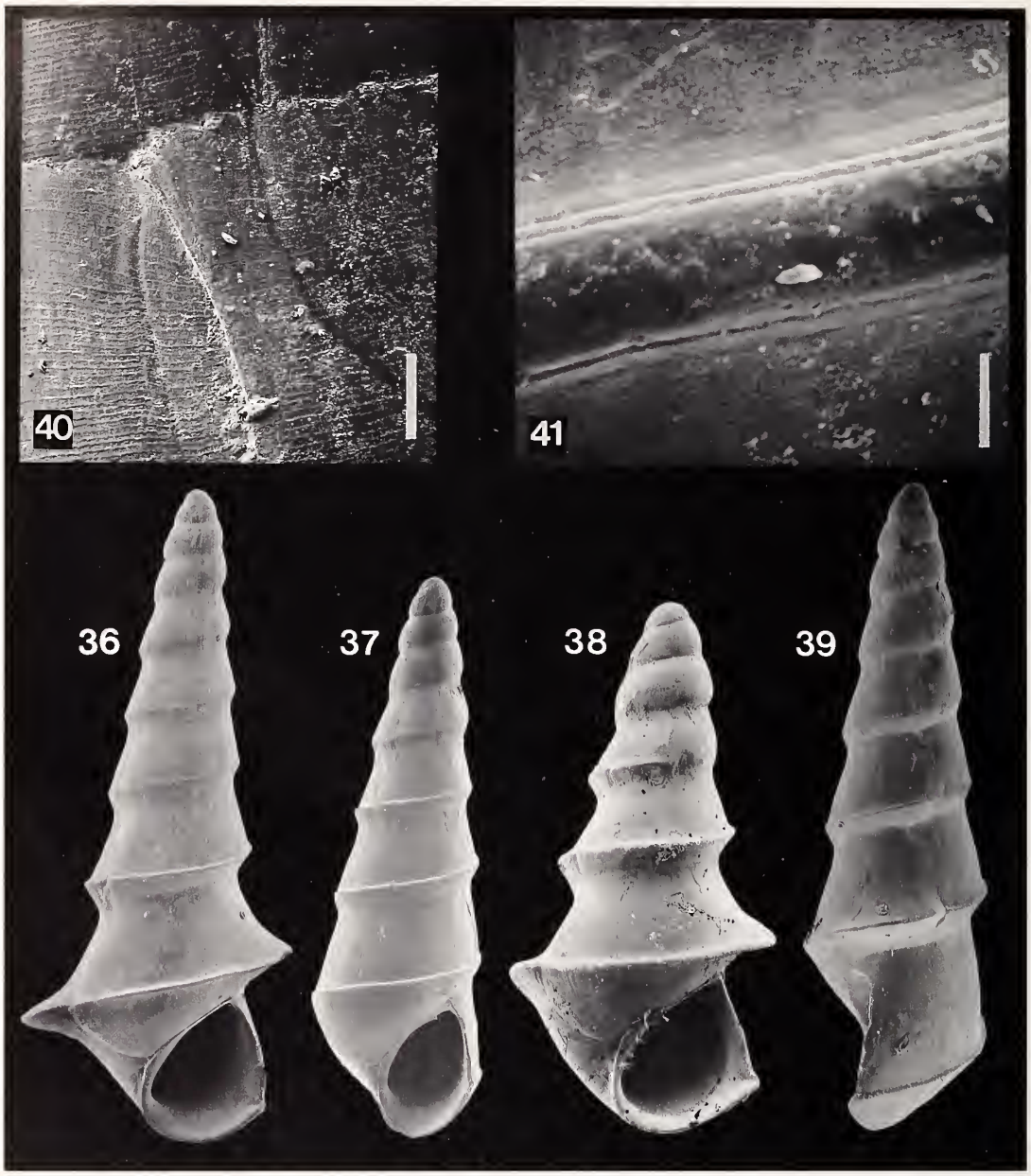
←

Figures 30 and 31. *Niso rangi,* Costa Rica, LACM 72-52.22, 3.8 mm and 3.0 mm.

Figure 32. *Eulimostraca macleani,* holotype, LACM 2370, 6.97 mm.

Figures 33 and 35. *Eulimostraca galapagensis,* syntype, USNM 251281, 3.5 mm.

Figure 34. *Eulimostraca macleani,* paratype, LACM 2371, 6.0 mm.



Explanation of Figures 36 to 41

Figure 36. *Eulimetta pagoda,* holotype, 2.0 mm.

Figure 37. *Eulimetta pagoda,* Guatemala, LACM 38-25.10, 1.12 mm.

Figure 38. *Eulimetta pagoda,* Costa Rica, LACM 72-43.4, 1.68 mm.

Figure 39. *Eulimetta pagoda,* paratype, 2.2 mm.

Figure 40. *Eulimostraca macleani,* paratype. Scale line 0.05 mm.

Figure 41. *Eulimetta pagoda,* paratype, keel. Scale line 0.01 mm.

Bandera, 20°45′N, 105°25′W, 3–5 m, 4 shells (LACM 65-16.47); Jalisco, Bahia Tenacatita, 19°17′N, 104°49′W, 1 shell (LACM 33-138.1); Jalisco, Bahia Cuastecomate, 19°13.8′N, 104°44.9′W, 18–36 m, 2 shells (LACM 2373). Guatemala: off Punta San Jose, 13°46′N, 91°14′W, 36 m, 1 shell (LACM 38-25.10). Costa Rica: Puntarenas Province, off Bahia Balena, 10°44.1′N, 84°59.5′W, 12 m, 1 shell (LACM 72-43.4).

Distribution: From Baja California Norte, 29°N, to Costa Rica, in 3–44 m depth.

Etymology: Named after the pagoda-like apparence of the lower whorls.

Description: The shell (Figures 36–39) is very small, very slender, chestnut brown, fairly solid, with the angulated periphery of the whorls often developed into a winglike keel. The larval shell (Figure 14), which is 210 μm high, has about 3.5 evenly rounded whorls with indistinct but sharp growth lines. The holotype has 5.5 teleoconch whorls, which except for the regularly appearing growth scars 0.5, 1.0, 1.5, and 2.0 whorls from the outer lip, have no sculpture visible with a stereomicroscope. Under SEM there are a few impressed spiral lines paralleling the peripheral keel (Figure 41) and the whole surface is covered by very small and shallow pits. Directly after the rather indistnctly demarcated protoconch starts a rounded keel, formed by a distinct bend in the profile of the whorl. This continues mostly unchanged for 1–4 whorls, after which it becomes more pronounced and keel-like, and transforms into a raised rib. Shortly before the outer lip it becomes lower again, a process that is repeated at each incremental scar; after an incremental scar the keel rapidly reaches maximum development. As a consequence of this growth pattern the shell looks strongly flattened, when observed from the side. The aperture is pear-shaped, with a small internal dent corresponding to the keel. The parietal callus is thick.

Dimensions. Height of holotype 2.02 mm, maximum diameter of body whorl 0.81 mm, minimum diameter of body whorl 0.54 mm; maximum height 2.32 mm.

Remarks: I am not aware of any species that can be confused with specimens with a developed keel; those with a poorly developed keel may possibly be confused with various species of ***Microeulima***, unless care is taken to look for the fine and sharp (but often indistinct) axial lines of those species.

Sabinella Monterosato, 1890

Sabinella Monterosato, 1890:160. Type species, *Eulima piriformis* Monterosato, 1875 (not Brugnone, 1873) = *Eulima bonifaciae* Nordsieck, 1974, Mediterranean, parasitic on test of *Cidaris cidaris* (Linnaeus, 1758).

Remarks: Several species of *Sabinella* are known to parasitize cidaroid sea urchins (Warén, 1984b; Bouchet & Warén, 1986; Warén & Moolenbeek, 1989; Warén & Mifsud, 1990) in galls in the spines or attached to the test.

The following species were placed in *Sabinella* by Bartsch (1917):

—*Sabinella chathamensis* Bartsch, 1917. This species does not belong to *Sabinella*, but is related to the Caribbean species "*Eulima*" *hians* Watson, 1883. It is probably better to provisionally place *chathamensis* in *Eulima*, a genus comprising a very heterogenous mixture of eulimids, and keep *Sabinella* as a monophyletic genus for this small group of cidaroid parasites.

—*Sabinella bakeri* Bartsch, 1917. This species probably is an eulimid despite having a rather fragile and irregular shell. I have examined a specimen with dried soft parts, and it has a ptenoglossate radula, similar to species of *Eulima*. It can provisionally be placed in *Eulima*.

—*Sabinella opalina* (de Folin, 1867). There is a possible syntype in the Museum of Comparative Zoology, Harvard University, No. 288749, which belongs in the genus *Melanella*.

—*Sabinella ptilocrinicola* Bartsch, 1907. Warén (1984b) placed this species in *Crinolamia* Bouchet & Warén, 1979. It lives on deep-sea crinoids.

—*Sabinella meridionalis* Bartsch, 1917, can provisionally be placed in *Eulima*.

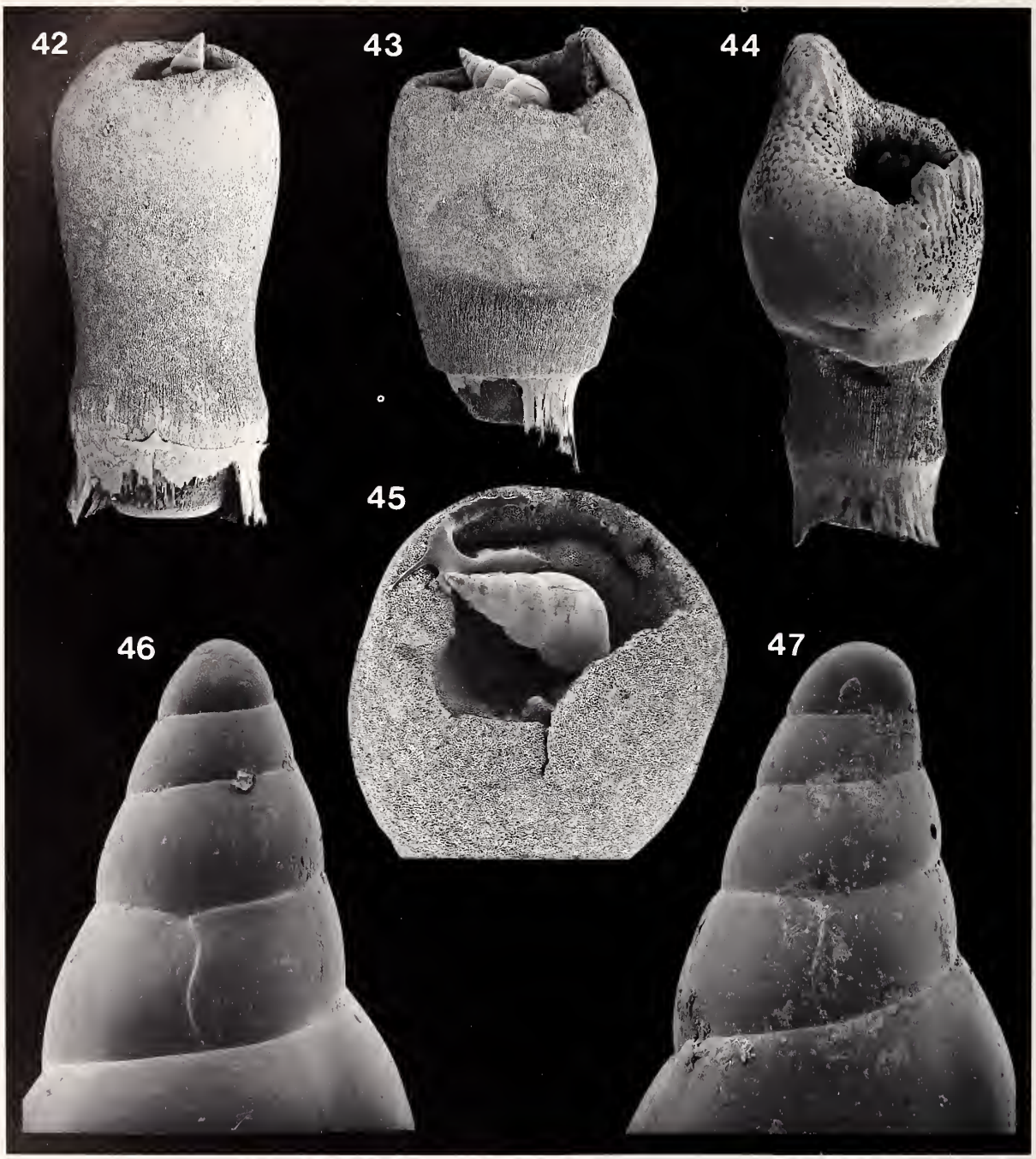
Sabinella ***shaskyi*** Warén, sp. nov.

(Figures 42–46, 48–52)

Type material: Holotype LACM 2374, 7 paratypes LACM 2375, 10 paratypes in D. Shasky collection, 12 paratypes SMNH 4378. All paratypes from Baja California Sur, El Pulmo Reef (see below).

Type locality: Mexico, Jalisco, 4.8 km (3 miles) NW of Barra de Navidad, 19°13.7′N, 104°44.8′W, 18–36 m, in a gall in a spine of *Eucidaris thourarsi* (Valenciennes, 1846), LACM 68-45.

Material examined (host *Eucidaris thourarsi*): Mexico: Baja California Sur, El Pulmo Reef, 1.5–3 m, several host specimens, 11 males, 14 females, 6 specimens left in galls (D. Shasky collection, paratypes in LACM and SMNH); Baja California Sur, off N end of Isla San Pedro Nolasco, 27°59′N, 111°24′W, 10 m, 1 shell (LACM 73-133); Baja California Sur, SE of Isla San Pedro Nolasco, 27°59′N, 111°24′W, 17–23 m, 1 shell (D. Shasky collection); Baja California Sur, Mulegé, rocky point in front of La Serenidad, 27°00′N, 111°58′W, 3 m, 2 empty galls (+ 1 specimen of *Nanobalcis* sp. nov.) (D. Shasky collection); Jalisco, Cuastecomate, 19°13.8′N, 104°44.9′W, 5–6 m, 1 apical spine with a gall with 1 male, 2 females, and egg capsules (D. Shasky collection); Nayarit, Isla Maria Madre, 1.6 km (1 mile) S of Puerto Ballena, 21.6°N, 106.5°W, 3–5 m, 3 assumed males from 1 host (D. Shasky collection); Nayrit, Banderas Bay, Islas Tres Mariaas, 20°45′N, 105°30′W, 5–10 m, on host, 1 apical spine with a small, healed gall, 1 dorsal spine with a gall with male, female, and egg capsules (LACM 65-14.7). Costa Rica: Isla del Coco, Baja Alcyone, 05°33′N, 87°00′W, 32–35 m, 2 hosts, each with 2 galls, each with male and female; 1 host with 2 specimens, no gall (D. Shasky collection); Isla del Coco, 05°33′N, 87°00′W, 21 m, 1 host with 1 healed gall, 1 gall with 2 males, 1 female (D. Shasky collection); Isla del Coco, Bahia Chatham, Punta Ulloa, 05°33′N, 87°00′W, 14–20 m, 1 young specimen 1.5 mm, no gall (D. Shasky



Explanation of Figures 42 to 47

Figure 42. *Sabinella shaskyi,* Costa Rica, Baja Alcyone, length of spine 6 mm.

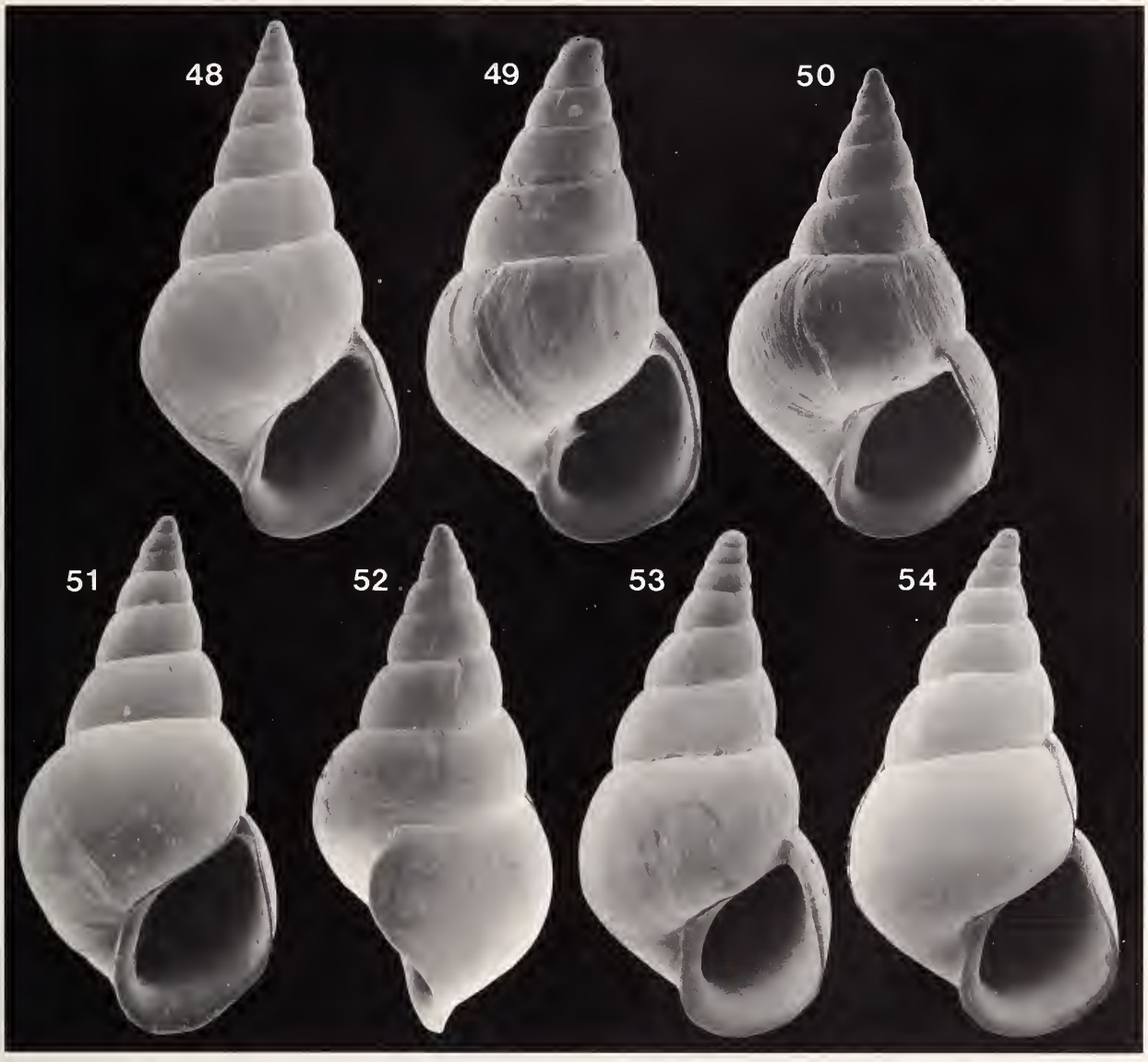
Figure 43. *Sabinella shaskyi,* Mexico, Coastocomate, diameter of spine 5 mm.

Figure 44. *Sabinella shaskyi,* Cocos Island, 21 m, length of spine 6 mm. This spine is regenerating, with three new points protruding from the rim of the gall.

Figure 45. *Sabinella shaskyi,* apical view of Figure 43, shell 2.5 mm.

Figure 46. *Sabinella shaskyi,* Mexico, Coastocomate, height of larval shell 450 μm.

Figure 47. *Sabinella troglodytes,* from *Eucidaris tribuloides,* Florida, off Cedar Key, 28°47.5′N, 84°37′W, 43 m, USFC station 2407, height of larval shell 430 μm.



Explanation of Figures 48 to 54

Figure 48. *Sabinella shaskyi,* Mexico, Cuastecomate, D. Shasky collection, 3.6 mm.

Figures 49 and 50. *Sabinella shaskyi,* Mexico, El Pulmo Reef, D. Shasky collection, 3.0 mm and 2.9 mm, respectively.

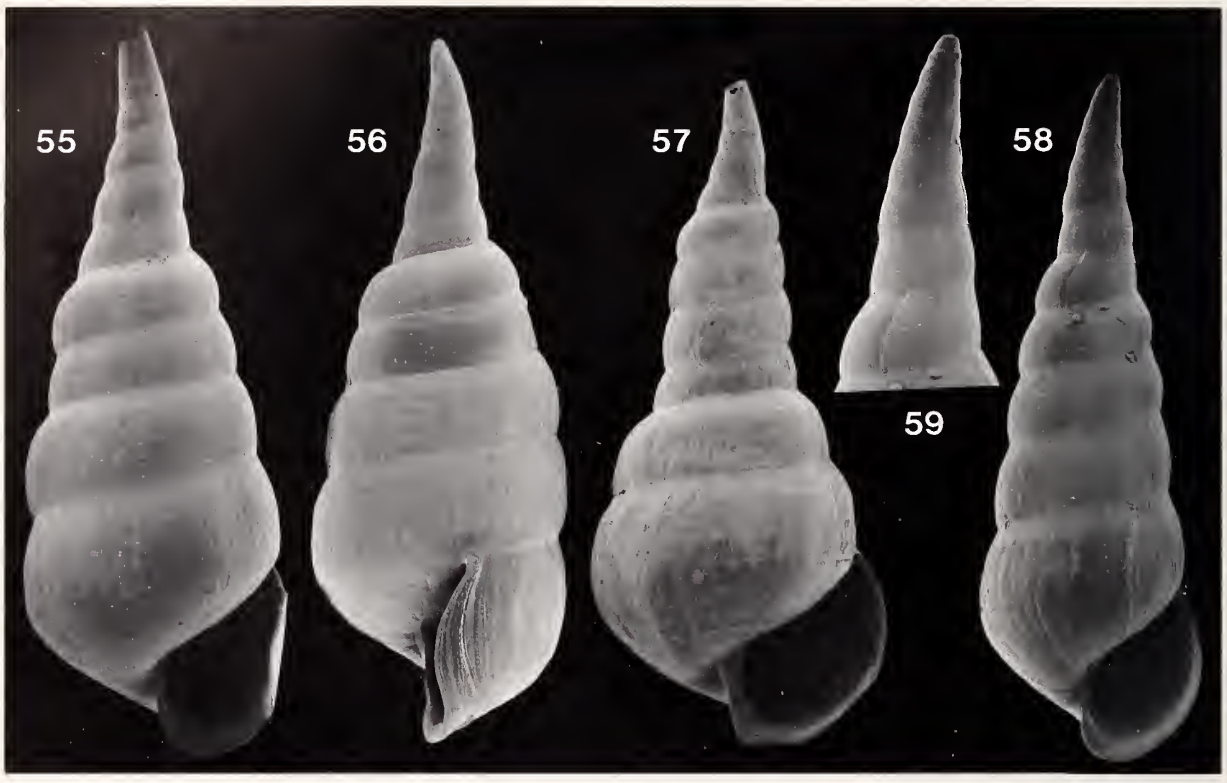
Figures 51 and 52. *Sabinella shaskyi,* holotype, LACM 2379, 3.0 mm.

Figures 53 and 54. *Sabinella troglodytes,* USFC station 2407, for data see Figure 47, 2.2 and 3.1 mm, respectively.

collection); Isla del Coco, Isla Manuelita, 05°33′N, 87°00′W, 13–17 m, 1 shell (D. Shasky collection); Isla del Coco, Isla Manuelita, 05°33′N, 87°00′W, 100–105 m, 1 shell (D. Shasky collection). ECUADOR: Galapagos Islands, Isla Marchena, 0°18′N, 90°30′W, 6 m, 1 shell (LACM 34-285.1); Galapagos Islands, Isla Isabela, Tagus Cove, 0°16′S, 91°23′W, 15 m, 1 shell (LACM 33-165.1); Galapagos Islands, Isla San Salvador, James Bay, 0°12′S, 90°52′W, 45 m, 1 shell (LACM 34-273.1); Manabi Province, N side of Isla La Plata, 01.1°S, 81.1°W, 10–27 m, in siftings, 2 small males, 1.6–1.7 mm (D. Shasky collection).

Distribution: From Ecuador, the Galapagos Islands, and Cocos Island north to Gulf of California, in about 5–45 m depth.

Etymology: Named after Dr. D. R. Shasky, who contributed much of the material of this study.



Explanation of Figures 55 to 59

Figures 55–59. *Scalenostoma subulata*. Costa Rica, Cocos Island, D. Shasky collection. Figure 55. Assumed primary female, lacking penis, height of shell 10.4 mm. Figure 56. Assumed primary female, with penis, height of shell 10.1 mm. Figure 57. Assumed secondary female, with penis, height of shell 11.3 mm. Figures 58 and 59. Assumed male, with penis, height of shell 8.0 mm. Figure 59. Apex enlarged, showing labial scar marking transition from normal eulimid to "*Scalenostoma* shape." The soft parts were too decayed to check for the presence of a pallial oviduct.

Description: *Female*. The shell (Figures 48–52) is small, grayish white, semitransparent, conical, somewhat irregularly coiled, usually with a slightly twisted or curved spire. The larval shell (Figure 46) is multispiral and distinctly demarcated from the teleoconch. The height is 450 μm. It has about 3.3 perfectly smooth whorls of rapidly increasing diameter and protoconch 1 is hardly discernible. The teloconch of the holotype has 4.5 whorls with distinct incremental scars 0.7, 1.4, 2.3, 3.0, 3.5, and 3.9 whorls from the larval shell, but the distance between them is subject to much individual variation. The whorls are quite convex with a shallow but distinct suture. The subsutural zone is not very distinct and occupies ¼–⅕ of the height of the whorls. The surface of the shell is perfectly smooth under a stereomicroscope, except for more or (usually) less distinct growth lines. Under SEM a fine striation, consisting of 4 fine rows of granulae per 10 μm, is visible. The aperture is almost triangular, pointed anteriorly and posteriorly. The outer lip is strongly protruding in its adapical part, most so at ⅓ of its height, counted from the suture.

Dimensions. Height of holotype 2.96 mm, maximum height 3.6 mm.

Male. The shell resembles that of the female but is slightly more slender, with a straighter spire, and is smaller, ⅔ of the height of the female.

Galls (Figures 42–45). Variously developed, depending on how long the host has been parasitized. Galls start as a simple lateral or apical depression on a normal-looking spine, inhabited by one or two young specimens. The spine then gradually becomes thicker by a change in its growth pattern and at the same time the depression becomes deeper. Finally the spine may become completely hollow, with a narrow, apical, or lateral pore, and the diameter of the gall may be twice the diameter of a normal spine.

Remarks: DÖDERLEIN (1887) figured and MORTENSEN (1928:397) mentioned the galls, noticed in specimens of *Eucidaris thourarsi* from Galapagos and Panama, but they were not aware of the cause.

SHASKY (1967) recorded this species under the name "*Rosenia nidorum* (Pilsbry, 1956)," from Baja California, an identification WARÉN (1984b) considered erroneous.

Sabinella ***shaskyi***, however, closely resembles *S. troglodytes* (Thiele, 1925) (= *Mucronalia nidorum* Pilsbry, 1956) (Figures 53, 54) from the Caribbean area and off West Africa. The two species can be distinguished mainly by the larval shell (Figure 47), which is more slender with flatter whorls in *S. troglodytes*.

Scattered large specimens (Figures 49, 50), of which one was confirmed to be a female, differ in having a less regularly coiled shell and distinct incremental lines. The larval shell is identical with that in normal specimens and I believe this to be individual variation.

All the specimens reported above, as well as the hosts, were dried, which made it difficult to make any observations on the soft parts. Furthermore, some of the snails had fallen out of the galls and additional small specimens may have been lost. A few selected specimens from galls were rehydrated, however, and three specimens smaller than 2 mm were confirmed to be males on the basis of a large penis. Three specimens larger than 2 mm but without a penis were assumed to be females. This conforms to the observations on three other species of *Sabinella* (Warén, 1984b; Bouchet & Warén, 1986).

In one case the occurrence of two females and a single male in a gall was confirmed, but no conclusions about the proportions of the sexes or the normal numbers of individuals per gall can be drawn.

Two specimens, 1.6 mm high and presumably males, were found free in a sediment sample taken in Ecuador. This indicates that the males may be able to leave the galls for courting.

Occasionally the galls are found empty or with empty shells inside, which indicates that the parasite probably has a shorter life-span than the host. (I have noticed this, several times in *S. troglodytes* also.) Finally, hosts can be found with the spines in a state of repair (Figure 44), with a new point of the spine growing out apically from an empty gall. All these transformations of the spines are possible since the spine is a porously calcified, living endoskeleton, not a lifeless calcareous structure, as is a spine of a *Murex* shell.

Sabinella ***shaskyi*** produces small spherical egg capsules containing about 100 eggs and attaches them to the floor of the gall, where up to a dozen capsules have been found.

Examination of 44 specimens of *Sabinella* ***shaskyi*** showed that 25% of the 24 specimens larger than 2 mm had the apex broken off, while not a single (out of 20) specimen smaller than 2 mm had a broken apex. All specimens with a broken apex had lived in incompletely formed galls. This shows two interesting features in the biology of the species: the snails are attacked by shell-cracking predators and the galls have a protective function.

Sabinella troglodytes lives in the same way as *S.* ***shaskyi***, on *Eucidars tribuloides* (Lamarck, 1816) in the Caribbean area and off West Africa. This host species has been assumed to be closely related to and to have diverged from *E. thouarsi* after the closing of the straits across the Central American isthmus (Mortensen, 1928) in the late Pliocene. Lessois (1981) investigated the morphologic and genetic variation between and within the two sea urchins and confirmed this assumption. It can therefore probably also be assumed that the two species of *Sabinella* have followed the same allopatric pattern of speciation.

ACKNOWLEDGMENTS

I thank J. H. McLean, who placed a large part of the eulimid collection in LACM at my disposal, and D. R. Shasky, Redlands, California, who always has been very helpful with material of tropical eulimids and contributed a large part of the specimens used for this study. C. Hammar, SMNH, prepared the photographic prints used for illustration. J. H. McLean and D. R. Shasky read and gave valuable comments on the manuscript.

LITERATURE CITED

Adams, H. & A. Adams. 1853 (1853–1854). The Genera of Recent Mollusca, Arranged According to Their Organization. 1. J. van Voorst: London. 484 pp. (Part 8, pp. 225–256, December 1853).

Bartsch, P. 1917. A monograph of west American melanellid mollusks. Proceedings of the U.S. National Museum of Natural History 53:295–356.

Bartsch, P. 1926. Additional new mollusks from Santa Elena Bay, Ecuador. Proceedings of the U.S. National Museum 69(2646):1–20.

Bartsch, P. 1938. *Leiostraca schwengelae*, a new name. Nautilus 52:34.

Berry, S. S. 1956. A new west Mexican mollusk parasitic on echinoids. American Midland Naturalist 56:355–357.

Bouchet, P. & A. Warén. 1979. The abyssal molluscan fauna of the Norwegian Sea and its relation to other faunas. Sarsia 64:211–243.

Bouchet, P. & A. Warén. 1986. Revision of the Northeast Atlantic bathyal and abyssal Aclididae, Eulimidae, Epitoniidae (Mollusca, Gastropoda). Bollettino Malacologico, Supplement 2:299–576.

Brann, D. C. 1966. Illustrations to "Catalogue of the Collection of Mazatlan Shells" by Philip P. Carpenter. Paleontological Research Institution: Ithaca, N.Y. 111 pp.

Carpenter, P. P. 1857. Catalogue of Mazatlan shells in the British Museum. British Museum: London. i–iv + ix–xvi + 552 pp.

Carpenter, P. P. 1864. Diagnoses of new form of mollusks collected at Cape St. Lucas by Mr J. Xantus. Annals and Magazine of Natural History, Series 3, 14:45–49.

Deshayes, G. P. 1863. Catalogue des mollusques de l'Ile de la Réunion (Bourbon). *In:* L. Maillard, Note sur l'Ile de la Réunion. Dentu: Paris. 144 pp.

Döderlein, L. 1887. Die Japanischen Seeigel. I. Familie Cidaridae und Salenidae. Schweitscherbartsche Verlagshandlung: Stuttgart. 56 pp.

Emerson, W. K. 1965. The eastern Pacific species of *Niso* (Mollusca: Gastropoda). American Museum Novitates 2218: 1–12.

de Folin, L. 1867. Les méléagrinicoles, espèces nouvelles. Imprimerie LaPelletier. 74 pp.

Hertz, C. M. & J. Hertz. 1982. A new eastern Pacific species of *Eulimostraca* (Gastropoda: Eulimidae). The Veliger 25: 72–76.

Keen, A. M. 1968. West American mollusc types at the British

Museum (Natural History). IV. Carpenter's Mazatlan collection. The Veliger 10:389–439.

KEEN, A. M. 1971. Sea Shells of Tropical West America. Stanford University Press: Stanford, California. 1064 pp.

KISCH, B. S. 1959. La collection de Chemnitzidae du Marquis de Folin au Muséum National d'Histoire Naturelle. Description de *Turbonilla corpulens*. Catalogue des espèces publiées par de Folin. Journal de Conchyliologie 99:89–112.

LESSOIS, H. A. 1981. Divergence in allopatry: molecular and morphological differentiation between sea urchins separated by the Isthmus of Panama. Evolution 18:618–634.

LYONS, W. G. 1989. Nearshore marine ecology at Hutchinson Island, Florida: 1971–1974. XI. Mollusks. Florida Marine Research Publications 1:1–131.

MCLEAN, J. H. 1970. New species of tropical eastern Pacific Gastropoda. Malacological Review 2:115–130.

MORTENSEN, T. 1928. A monograph of the Echinoidea. I. Cidaroidea. C. A. Reitzel: Copenhagen. 551 pp.

MORTENSEN, T. 1948. A monograph of the Echinoidea. IV:2. Clypeasteroida. C. A. Reitzel: Copenhagen. 471 pp.

MONTEROSATO, T. A. DI. 1890. Conchiglie delle profondita di Mare di Palermo. Il Naturalista Siciliano 9:157–166.

PETIT, DE LA SAUSSAYE. 1853. Bulletin Bibliographique. Journal de Conchyliologie, Paris 4:216–218 (Issue for May 1853).

PHILIPPI, R. A. 1853. Handbuch der Conchyliologie und Malacozoologie. E. Anton: Halle. 548 pp.

PONDER, W. F. & A. WARÉN. 1988. Classification of the Caenogastropoda and Heterostropha—a list of family-group names and higher taxa. Malacological Review Supplement 4:288–326.

RISSO, A. 1826. Histoire naturelle de l'Europe méridionale. 4. Levrault Libraire: Paris. 439 pp.

SHASKY, D. R. 1967. Observations on *Rosenia nidorum* (Pilsbry) and *Arene socorroensis* (Strong). Annual Report of the American Malacological Union 1967:74.

SHASKY, D. R. 1983a. A preliminary check-list of marine mollusks, from Manabi Province, Ecuador. Annual Report, Western Society of Malacologists 16:25–32.

SHASKY, D. R. 1983b. New records of Indo-Pacific Mollusca from Cocos Island, Costa Rica. Nautilus 97:144–145.

STRONG, A. M. & L. G. HERTLEIN. 1937. The Templeton Crocker Expedition of the California Academy of Sciences 1932, No. 35. New species of Recent mollusks from the coast of western North America. Proceedings of the California Academy of Sciences, Series 4, 22:159–178.

WARÉN, A. 1980. Revision of the genera *Thyca, Stilifer, Mucronalia, Scalenostoma* and *Echineulima* (Mollusca, Prosobranchia, Eulimidae). Zoologica Scripta 9:187–210.

WARÉN, A. 1984a. An anatomical comparison of *Eulima* and *Pyramidelloides* with a revision of the species of *Pyramidelloides* (Mollusca, Prosobranchia, Eulimidae). Zoologica Scripta 12:273–294.

WARÉN, A. 1984b. A generic revision of the family Eulimidae (Gastropoda, Prosobranchia). Journal of Molluscan Studies 13(Suppl.):96 pp.

WARÉN, A. 1991. Revision of *Hypermastus* Pilsbry, 1899 and *Turveria* Berry, 1956 (Gastropoda: Prosobranchia: Eulimidae), two genera parasitic on sand dollars. Records of the Australian Museum 43:85–112.

WARÉN, A. 1992. *Balea* Gray, 1824 (Mollusca: Gastropoda): proposed conservation. Bulletin of Zoological Nomenclature 49:12–15.

WARÉN, A. & R. MOOLENBEEK. 1989. A new eulimid gastropod, *Trochostilifer eucidaricola,* parasitic on the pencil urchin *Eucidaris tribuloides* from the southern Caribbean. Proceedings of the Biological Society of Washington 102:169–175.

WARÉN, A. & C. MIFSUD. 1990. *Nanobalcis,* a new eulimid genus (Prosobranchia) parasitic on cidaroid sea urchin, with two new species and comments on *Sabinella bonifaciae* (Nordsieck). Bollettino Malacologico 26:37–46.